CHAPTER 1

DENTAL RADIOLOGY

INTRODUCTION

The purpose of dental radiography is to record images of a patient's oral structures on film by using X-rays. When the X-ray films are processed, the resulting radiographs provide the dental officer with a valuable diagnostic aid. In the case of death, radiographs can be used to aid in identification as discussed in chapter 10, "Forensic Dentistry."

The first section of this chapter covers the basic fundamentals of dental radiography. Included are the physics and biology of radiography.

Since X-radiation can be harmful, you must observe certain safety precautions when using an X-ray machine or working in an area where one is being used. These precautions are covered in the second part of this chapter.

The major portion of this chapter is devoted to explaining how to operate a dental X-ray machine, expose intraoral radiographs (radiographs taken inside the patient’s mouth), process the X-ray films, and mount the finished radiographs.

The last part of this chapter covers the panoramic X-ray machine, which you will use to make extraoral radiographs (radiographs made outside the patient’s mouth).

FUNDAMENTALS OF DENTAL RADIOLOGY

Oral radiography is the art of recording images of a patient’s oral structures on film by using X-rays (roentgen rays). The rays were recognition of Wilhelm Konrad Roentgen, a scientist, who first discovered X-rays in 1895. While experimenting with a device called a Crookes tube, which generated cathode rays, he noted that a photographic plate completely wrapped in black paper and lying near the tube was fogged when developed. He realized that some form of invisible ray, able to pass through the black paper, must be coming from the tube. Later, while in his darkened laboratory, he noticed that a fluorescent screen located six feet away was glowing. He knew that the cathode rays could travel only short distances outside the cathode tube and realized he was observing a new, unknown ray, which he called an X-ray because the symbol "X" is used for the unknown in mathematics.

The first dental radiograph was taken the same year by Dr. Otto Walkoff. Within 10 years, radiographs were being used for diagnosis of medical and dental conditions, for X-ray therapy, and- for scientific studies. Although technology over the years has made tremendous improvements in X-ray equipment, the basic concepts are the same.

Like visible light rays, X-rays are electromagnetic rays that travel in a wave motion. The measurement of this wave motion is called a wavelength. The basic difference between X-rays and other electromagnetic rays is in their wavelength. X-rays have an extremely short wavelength, which enables them to penetrate matter that usually absorbs or reflects light or other electromagnetic rays with longer wave-lengths.

Although X-rays share the properties of other electromagnetic rays, their action is considerably different. Some of the characteristics and properties of X-rays are:

- They travel in straight lines at the speed of light.
- They affect photographic film by producing a hidden image made visible by processing.
- They cause certain substances to fluoresce (glow).
- They cause irritation of living cells and, in large amounts, can cause necrosis (death) of the cells, a fact that necessitates caution in using X-rays.

X-rays are produced when a metal (tungsten) target is bombarded by a stream of electrons. The X-rays are emitted in the tubehead and directed by the tubehead cone through the subject, producing an image on the film.

The density of the X-ray image is controlled by four factors: kilovoltage (kVp), exposure time, milliamperage (mA), and target-film distance (TFD). All of these factors are interrelated and may be varied by the operator. The procedures for setting these factors will be discussed later.

RADIATION SAFETY

Proper safety precautions must be observed by all persons working in or near an area where X-rays are being generated. X-rays can be dangerous. Long term overexposure to radiation may result in loss of hair, redness and inflammation of the skin, blood count change, cell atrophy (wasting away), ulcerations, sterility, genetic damage, cancer, leukemia, and death.

There are safety measures designed to protect the patient and the health care team from the dangers of overexposure to radiation and the operation of X-ray equipment. You must observe these safety measures when working in radiology. Your command will have instructions and standard operating procedures (SOP) for the operation of dental radiographic (X-ray) units and equipment. You will be required to read these procedures if you are newly assigned to the radiology department. There are other numerous responsibilities that include providing radiology support for oral diagnosis, log maintenance, infection control, testing for quality control, and processor maintenance.

PATIENT PROTECTION

A number of precautions are taken to prevent the patient from being exposed to inappropriate diagnostic radiation. The decision to order dental radiographs is determined by the dental officer on a case by case basis for each patient. **Only** a dental officer is authorized to order and diagnostically interpret dental radiographs.

Perhaps the most important safety measure is the responsibility of the assistant: **When taking radiographs, you should always have patients wear lead aprons and thyroid collars to shield their reproductive organs and thyroid glands. There is only one exception to this rule; when obtaining a panorex radiograph, the thyroid collar is not used since it blocks part of the X-ray beam.** In addition, always ask a female patient whether or not she is pregnant or if pregnancy is questionable, before taking radiographs. If she is pregnant, consult the dental officer.

Other radiation safety measures include X-ray machines that have built-in safeguards that filter out harmful radiation and restrict the central X-ray to the smallest possible area. Fast film is used to shorten expos ure time; and only essential radiographs are taken on patients.

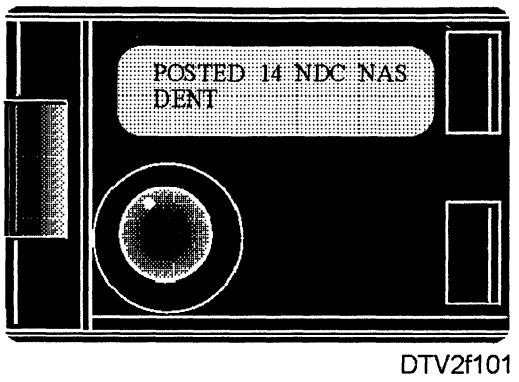


Figure 1-1.—Environmental dosimetry radiation film badge.

ASSISTANT PROTECTION

When you work near a source of radiation, your X-ray department will be issued an environmental dosimetry radiation film badge (fig. 1-1).

Appropriately placed environmental film badges are used to monitor stray radiation that may occur in and around the X-ray department. The badges are placed in the X-ray room behind the technicians protective lead-lined barrier or at least 6 feet from the tube head and never in the direct line of radiation during expos ure. These film badges contain X-ray sensitive film in a light-tight packet. The film packets are collected every 6 to 7 weeks. After collection, the film is sent to the radiation detection laboratory for processing and evaluation. Any abnormally high readings (i.e., greater than 0.010 REM [Radiological Equivalent Mammel]) shall be referred to the Radiation Health Office for investigation.

When you take radiographs on a patient, observe the following precautions to avoid unnecessary exposure to radiation:

- NEVER stand in the path of the central X-ray beam during exposure.
- NEVER hold the X-ray film packet in the patient's mouth during exposure.
- NEVER hold the tube head or the tube head cylinder of the X-ray machine during exposure.
- ALWAYS stand behind a lead-lined screen during an exposure.

X-RAY FILM LOG

Another portion of radiation safety is to account for all radiographs that are taken. An X-ray film log

shall be maintained in all X-ray rooms and will contain the following information:

Column 1: Patient's Name

Column 2: Patient's SSN

Column 3: Patient's Unit

Column 4: Rank/Rate/Retired/Dependent/etc.

Column 5: Number of X-ray exposures and type: bitewing, periapical, occlusal, panograph

Column 6: kVp, mA, exposure time

Column 7: Reason retake X-ray required (if applicable)

When stating the reason for a retake X-ray, be specific on the nature of the retake, for example: conecut, elongated, foreshortened, dark image, etc.

DENTAL X-RAY MACHINES

The most commonly used X-ray machine is the wall-mounted dental X-ray unit (fig. 1-2). Because the basic components and operating techniques of all dental X-ray machines are similar, we will only discuss the wall-mounted unit. The component parts of the wall-mounted machine discussed here are the tube head, cylinder, extension arm, ready light, and a separate control panel.

TUBE HEAD

The tube head (fig. 1-3) contains the X-ray tube and other components necessary for generating X-rays. When an exposure is made, X-rays pass through an aluminum filter that screens out unnecessary radiation. Angulation scales are on both sides of the tube head for precise positioning technique.

CYLINDER

The cylinder (or cone) is affixed to the tube head and is used to align the tube head with the patient and the X-ray film. It is open-ended and composed of lead laminated material that establishes the minimum distance from the X-ray source to the patient's skin.

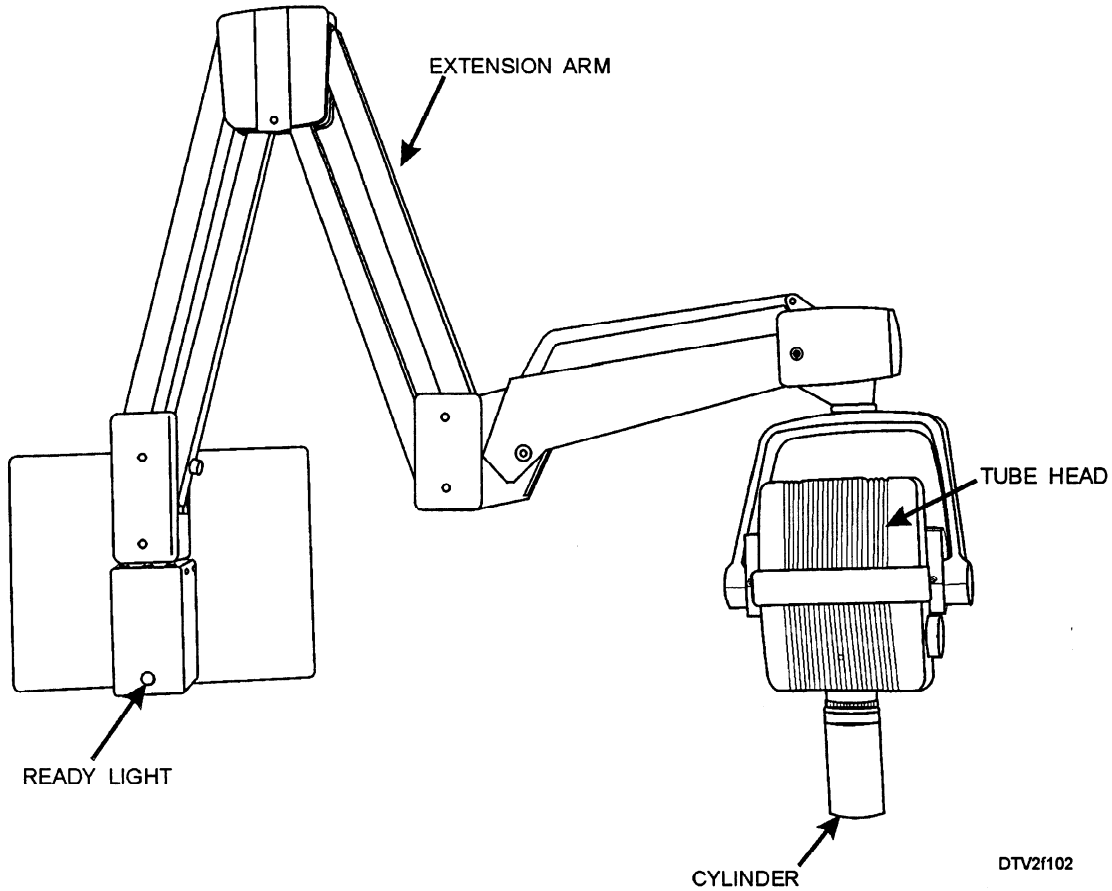


Figure 1-2.—Wall-mounted X-ray machine.

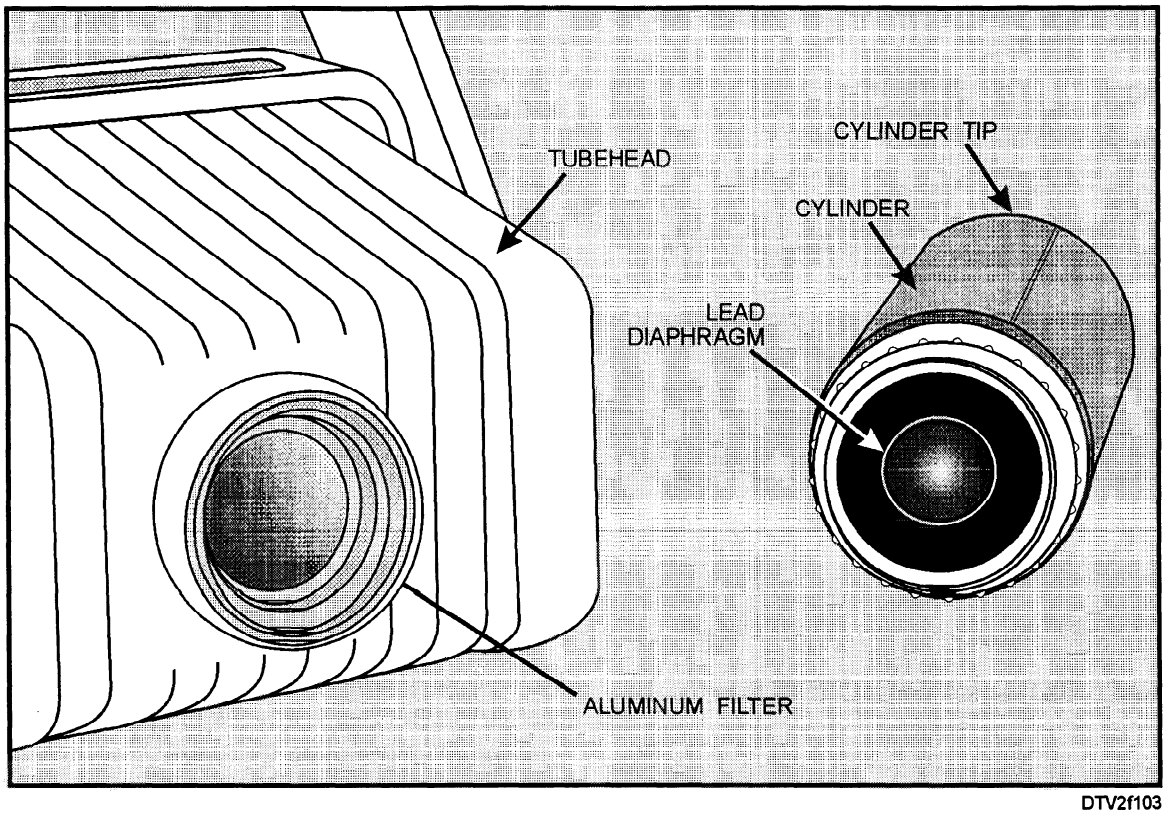


Figure 1-3.—Tube head and cylinder (short cone).

The X-ray beam passes from the aluminum filter through an opening in a lead diaphragm, which restricts the beam to 2.6 inches at the cylinder tip. There are two commonly used cylinder lengths. A tube head with an X-ray source to cylinder end distance of 8 inches is referred to as a "short cone" machine, while a tube head with an X-ray source to cylinder end distance of 16 inches is referred to as a "long cone" machine. It is essential that the technician knows the X-ray source to cylinder end distance in order to set the appropriate exposure settings.

The tube head is attached to an extension arm. The extension arm is movable, allowing you to adjust the position of the tube head for each patient.

CONTROL PANEL

The operational controls on the control panel are covered in the discussion on the operational check.

OPERATIONAL CHECK (WITHOUT PATIENT)

At the beginning of each workday, you should activate the X-ray machine to ensure that it is working properly. This operational check is conducted without a patient in the chair. In order to check the machine, you must be thoroughly familiar with its operation. Read the manufacturer's instructions carefully.

Throughout this discussion of the operational check, refer to figure 1-4. The steps of procedure are:

1. Energize the control panel. The control panel shown in figure 1-4 has three push buttons in the upper left corner. By depressing either the 10 mA or the 15 mA pushbutton, you will energize the machine and select the milliampere setting at the same time. Once the button is depressed the "power on" light will glow amber, indicating that the system is turned on. (A setting of 10 mA is normally used for intraoral radiographs.)

NOTE: Some machines have separate master on/off switches. On these machines, you should FIRST activate the master switch, and then select the milliamperes (10 mA or 15 mA) setting. A 10 mA setting is used for most dental radiographs. Some units use a combination master on/off switch and mA selector to energize the machine.

2. Set the tube head selector. On units with multiple tube head capabilities, depress the pushbutton that corresponds to the tube head to be used, normally

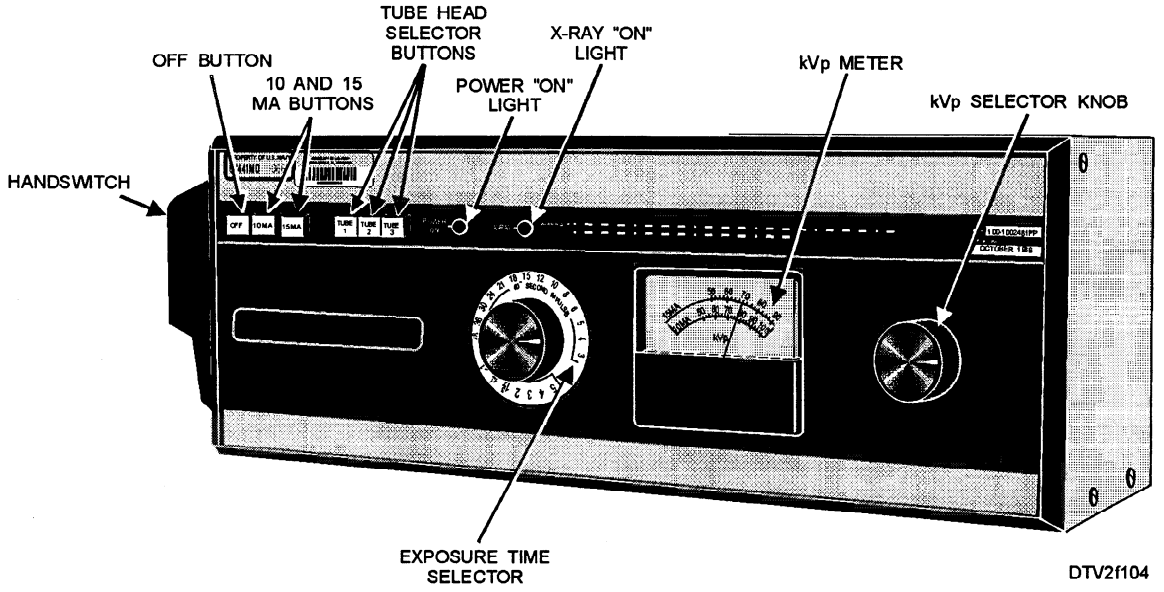


Figure 1-4.—Control panel for wall mounted X-ray machine.

tube 1. The depressed button and a lamp on the selected tube head will glow.

3. Select the kilovoltage. Adjust the kilovoltage (kV) until the desired kilovolt peak (kVp) is registered on the kilovolt meter. The kVp setting will vary, depending on the patient's bonesize and density; specific settings will be given later in this chapter.

NOTE: Some X-ray machines shut off automatically if the setting exceeds 90 kVp. Refer to the manufacturer's instructions for resetting procedures.

4. Set the exposure time. Check the X-ray film manufacturer's recommended time setting for the type of film being used, the kVp and mA settings, and the film focal distance (FFD). The time settings may be in fractions of a second or impulses. An impulse equals 1/60 of a second. To protect the patient from needless exposure to radiation, use the minimum exposure time necessary to produce the desired results.

5. Check to see that the machine is emitting X-rays. Place an unexposed packet of X-ray film on the seat of the dental chair. Put a penny on top of the film packet and position the tube head. The tube head cylinder should be pointed down, 6 inches above and centered on the penny. When the tube head is correctly positioned, prepare to make the exposure.

WARNING: You must be behind a lead-lined shield or at least 6 feet from the tube head when making the exposure.

6. Make the exposure by depressing the exposure button located on the control panel. Exposure start is delayed approximately 1/2 second. If the machine is working correctly, you will hear a click and the tone signal, and the "X-ray" lamp on the control panel will glow. This indicates that an exposure is being made. **Do not release the exposure switch until the selected exposure time is completed.**

7. After making the exposure, process the X-ray film. If the processed film shows a light area where the penny was, the X-ray machine is working properly. Processing techniques will be discussed later in this chapter.

MACHINE OPERATION (WITH A PATIENT)

Once the X-ray machine's operational readiness check has been completed, it is a simple matter to prepare it to take radiographs on a patient. Set the mA selector, the tube head selector (if necessary), the kVp selector, and the exposure time. Before you make the exposure, position the patient, the film packet, and the tube head cylinder. These patient positioning procedures are discussed later.

SECURING THE X-RAY MACHINE

At the end of each work day, deactivate the off switch and secure the machine (e.g., the tube head extension arm should be completely folded to minimize the weight of the tube head on the arm and wall mounting plate).

USER MAINTENANCE

An X-ray machine is very expensive. Do everything possible to keep it in good working order by following the user maintenance procedures contained in the manufacturer's instructions.

General user maintenance includes dusting the X-ray machine daily, and removing blood and debris from all surfaces using a cloth moistened with detergent solution. Follow disinfection procedures discussed later in the chapter.

NOTE: DO NOT use a wet cloth; moisture might enter the control panel causing an electrical short circuit that could cause severe damage to the machine and possible harm to the operator. DO NOT use cleaners or solvents.

Never attempt to repair the X-ray machine yourself. If it breaks down, report it to your supervisor. All repairs are the responsibility of the dental equipment repair technician.

INTRAORAL RADIOGRAPHS

Intraoral radiographs are made with the X-ray film placed inside the patient's mouth. There are three types of intraoral radiographic examinations: periapical examination, interproximal (bitewing), and the occlusal.

To ensure diagnostic quality radiographs, you must properly align the X-ray film, the area to be X-rayed, and the tube head cylinder of the X-ray machine. Alignment can be accomplished by using either the parallel film placement technique (preferred method) or the bisecting angle technique. The following discussion provides detailed information on how to take periapical and interproximal (bitewing) radiographs, using both techniques. For the occlusal examination, you will use only the bisecting angle technique.

INTRAORAL FILM

The X-ray films used for intraoral examinations differ in size, depending on the type of examination. Figure 1-5 compares the sizes of periapical, interproximal (bitewing), and occlusal film.

There are different speeds of film. The most commonly used is an ultraspeed film known as D speed film. Ektaspeed (or E speed) film requires less radiation per exposure than D speed film. Some commands are now using E speed film. The exposure

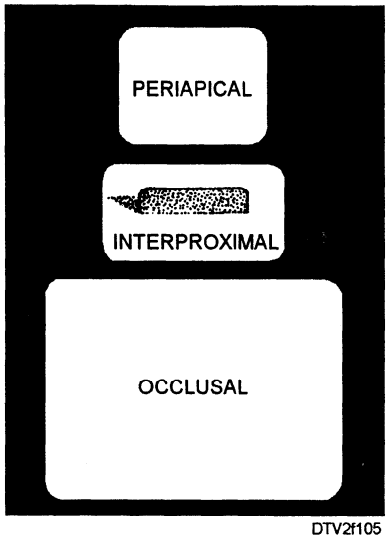


Figure 1-5.—Intraoral X-ray film.

times given in the following sections are for D speed film.

Intraoral film comes in film packets, with a lightproof and waterproof outer wrapper. Inside the wrapper, the film is sandwiched between black protective paper and backed with lead foil. Figure 1-6 shows a partially unwrapped periapical film.

STORAGE

Intraoral film can be ordered through normal supply channels. It must be stored in a cool, dry area. In very hot or damp climates, the film should be refrigerated. Never store it near steam lines or radiators, and never store it near film processing

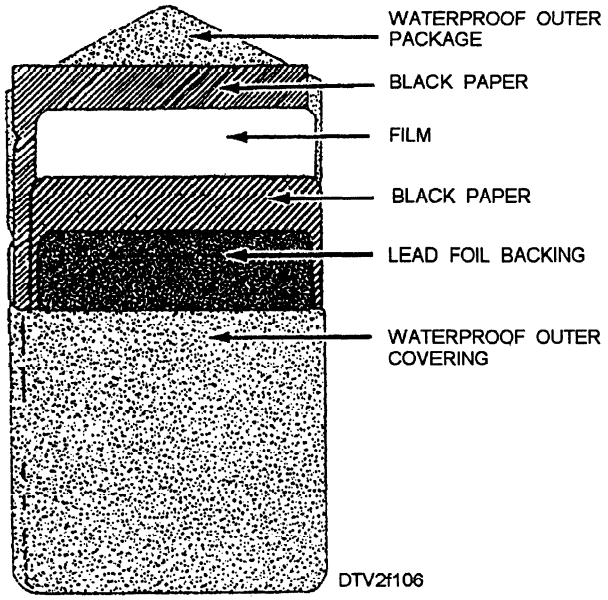


Figure 1-6.—Partially unwrapped periapical film.

solutions, since the escaping fumes could damage the film.

Because the unprocessed film is sensitive to X-rays, it must be stored in lead lined containers, as shown in figure 1-7 in the open and closed position. Remove only one film at a time from the lead film dispenser, make the exposure, and place the film in a clean paper cup or disposable container. Place the cup or disposable container in a lead container or behind a protective screen before making the next exposure. Repeat this procedure for each exposure. Maintain a minimum stock of film, and use the oldest film first so the stock is always fresh.

PRECIOUS METALS RECOVERY PROGRAM (PMRP)

The precious metals recovery program is designated to save Department of Defense (DOD) money by recycling precious metals and using those funds to offset the cost of supplies for DOD activities. Both silver and lead are precious metals that are found in the X-ray department. The silver is found in used fixer solutions and on dental films. The lead is found in X-ray packets. These precious metals should be saved and turned into the supply department following the guidelines in BUMEDINST 4010.3, "Precious Metals Recovery Program."

ASSISTANT PREPARATION

To protect yourself and the patient from diseases, perform the handwashing and gloving procedures covered in *Dental Technician,* Volume 1, chapter 9, "Infection Control ."

PATIENT PREPARATION

To properly prepare a patient for an X-ray procedure, you should employ the following techniques:

- Ensure all infection control procedures are followed.

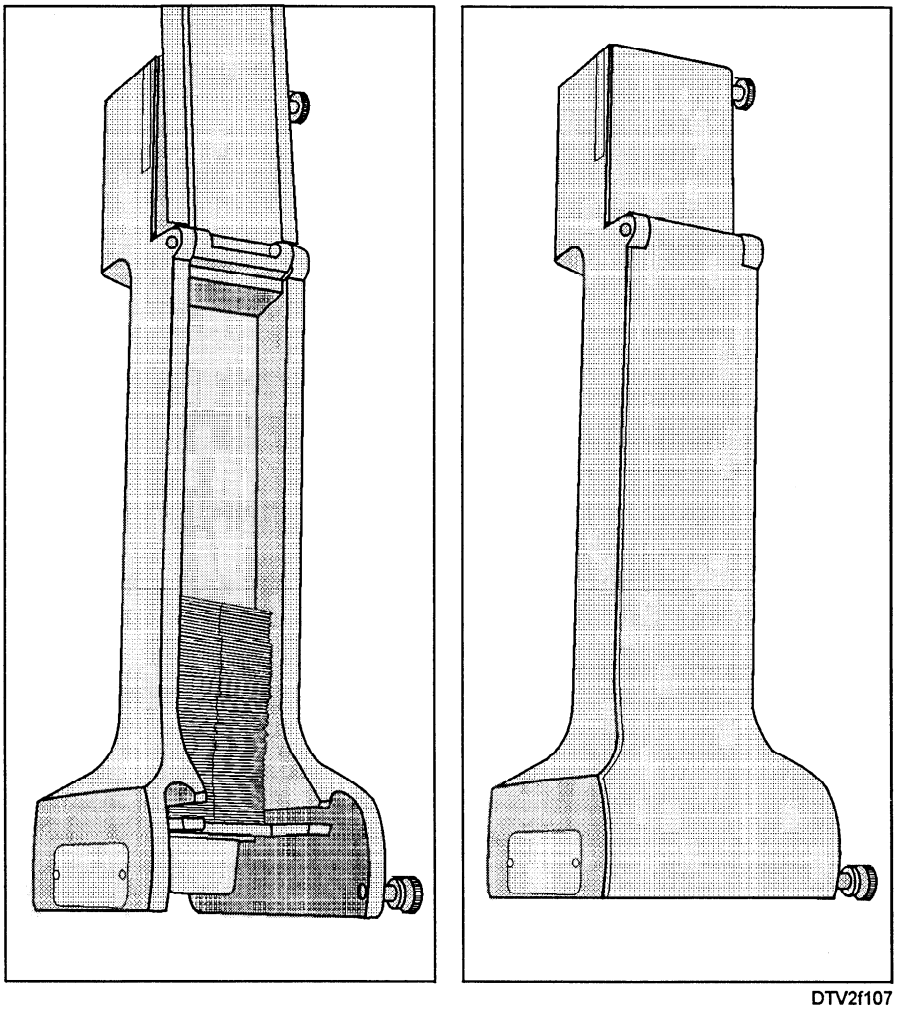


Figure 1-7.—Lead lined container.

- Seat and position the patient. Positioning varies according to the type of radiographic examination and the film placement technique you are going to use. Specific positioning procedures will be discussed later.

- If the patient is a woman, ask her if she is pregnant. If she is or you suspect that she might be, consult the dentist.

- Ask the patient to remove eyeglasses, complete dentures, removable partial dentures, earrings, or any other objects about the head and neck.

- Explain the X-ray procedures to the patient. If the patient is nervous about being X-rayed, explain the safety precautions taken to prevent overexposure to radiation.

- **Drape the patient with a lead apron and thyroid collar.**

- Quickly examine the patient's mouth to determine its anatomy. Such things as a small mouth, an abnormally shallow vault, crooked teeth, and bony protrusions can affect the placement of the film packet. The patient's overall bone size and density will determine the kVp setting. For a patient with a normal bone size and density, use a kVp setting of 87; for a patient with a thick bone size and density, use a 90 kVp setting.

- Position the patient's head securely against the headrest.

- Place the film packet in the patient's mouth. Film placement procedures will be discussed later. Occasionally patients may gag when the film is placed in their mouth. The gagging reflex may be caused by nervousness, so remain calm and reassure the patient. You might recommend that patients breathe through their nose, since it is difficult to gag while doing so, having patients rinse out their mouth with cold water may also help or have patients concentrate on something other than gagging. Whatever technique you use you will have to be swift in placing the film and making the exposure because the chance of keeping the gag reflex from returning for an extended period is highly unlikely.

- After the X-ray procedure is completed, you must store the lead apron and thyroid collar properly to avoid damage as shown in figure 1-8.

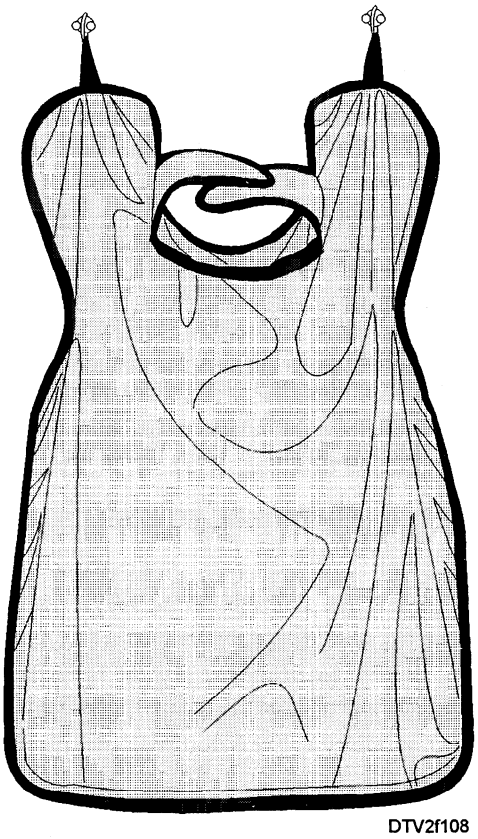


Figure 1-8.—Properly stored lead apron with thyroid collar.

PERIAPICAL EXAMINATION

A periapical examination is conducted to obtain radiographs of the crowns, roots, and supporting structures of the teeth. Figure 1-9 shows a typical periapical radiograph.

There are two techniques available to take periapical radiographs: paralleling and bisecting-angle. Both techniques use the long axis of the tooth as a focal point. The paralleling technique is the preferred method and the bisecting-angle technique is used as an alternative. Film placement and techniques are discussed in the following sections.

PARALLELING TECHNIQUE

When using the paralleling technique, you must center the X-ray film packet behind, and parallel with

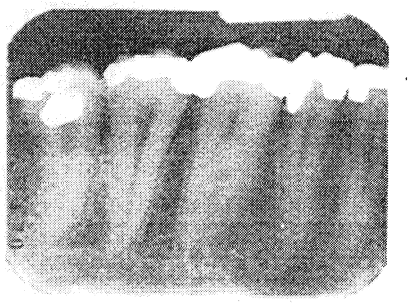


Figure 1-9.-Typical periapical radiograph.

the long axis of the tooth being X-rayed. A tube head with a 16-inch X-ray source to cylinder end distance (long cone) should be used with the paralleling technique. The tube head must be positioned so that the central X-ray beam is projected perpendicular to the tooth and the film packet. To properly position the film and the tube head, use paralleling devices.

There are two different paralleling devices. One is used for radiographs of the anterior teeth; the other is used for radiographs of the posterior teeth. Each paralleling device consists of a bite-block, an indicator rod, and locator ring (fig. 1-10). The bite-block has a slot and a film backing support to hold the X-ray film packet.

Assembling The Anterior Device

Figure 1-11 shows a fully assembled anterior paralleling device. Refer to this figure during the following explanation on assembling the paralleling device:

- Grasp the periapical film packet between the thumb and first two fingers of your right hand. The printed surface of the packet should be facing you, and the side with the raised dot should be in the film positioning slot of the paralleling device.

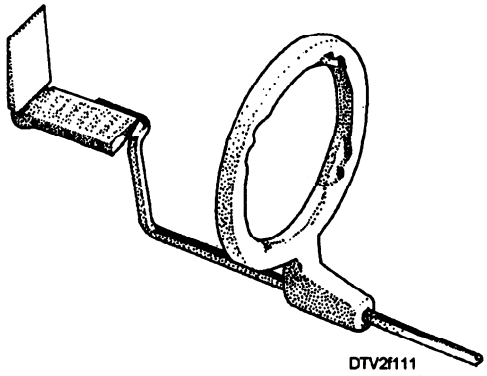


Figure 1-11.—Assembled anterior paralleling device.

- Hold the base of the anterior bite-block between the thumb and first two fingers of your left hand. Ensure that the plastic film support is pointed upward and the film positioning slot is away from you.

- Holding the film packet in position, press it against the plastic support and slide the film down into the positioning slot. The printed side of the packet should be facing the plastic support, and the raised dot should be located toward the positioning slot.

- The two prongs of the indicator rod are inserted into the openings in the bite-block.

- Slide the anterior locator ring onto the indicator rod. Look through the locator ring. If the bite-block and

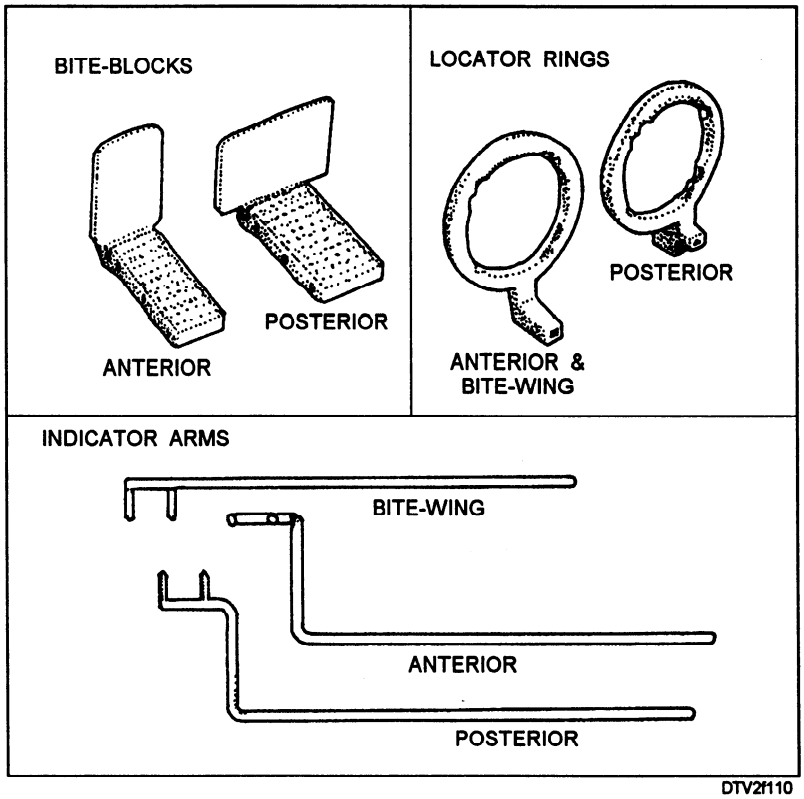


Figure 1-10.—Anterior and posterior paralleling devices.

film are centered in the locator ring, the device is properly assembled and ready for positioning in the patient's mouth.

Assembling The Posterior Device

Figure 1-12 shows a fully assembled posterior paralleling device. Refer to this figure during the following discussion.

- Insert the film into the posterior bite-block as previously discussed.

NOTE: The posterior device shown in figure 1-11 is used for film placement in the right maxillary and left mandibular quadrants. You must reassemble the device, rotating the locator ring and the bite-block, before using it in the left maxillary or right mandibular quadrants. Only the posterior device must be reassembled in this manner, the anterior device **does not** require reassembly.

Placing The Device

Once you have assembled the posterior paralleling device, place it in the patient's mouth. Be very careful not to injure the oral tissue. If the patient gags, use the remedies discussed earlier.

Guide the bite-block and the film packet into position, centering the packet behind the area being X-rayed. The film packet should be positioned far enough behind the tooth so it will be parallel to the long axis of the tooth.

After positioning the film packet, slide the locator ring down the indicator rod until the ring almost touches the surface of the patient's face. Then, position the tube head cylinder. The end of the cylinder should be parallel with the locator-ring, and its side should be parallel with the indicator rod.

Once these procedures have been accomplished, the film packet and the tube head are in proper alignment. You are now ready to expose the film.

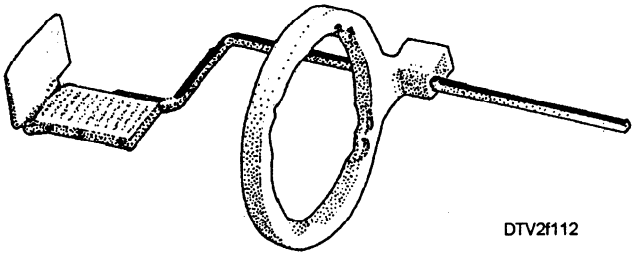


Figure 1-12 .—Assembled posterior parallelling device.

EXPOSURE ROUTINE FOR FULL MOUTH PERIAPICAL EXAMINATION

The full mouth periapical examination consists of 14 periapical radiographs (7 maxillary and 7 mandibular). The series includes the following films and sequence starting with the maxillary arch and proceeding to the mandibular arch:

1. Incisor area
2. Left cuspid area
3. Left bicuspid area
4. Left molar area
5. Right cuspid area
6. Right bicuspid area
7. Right molar area

GUIDELINES FOR TAKING PERIAPICAL RADIOGRAPHS, PARALLELING TECHNIQUE

The following guidelines apply if you are taking either a full mouth series, or an individual periapical radiograph. For training purposes, infection control barriers are not used in the photographs in this section.

In most cases, the X-ray machine is set at 10 mA for dental radiographs. The kVp may vary, depending upon the thickness or the region being radiographed. If the area being radiographed is edentulous (no teeth present), reduce the recommended kVp by 5. When you are taking radiographs on a child, reduce the recommended kVp to 70. Always consult the dentist before taking radiographs on a child. Because of the different types of X-ray equipment in use, the exposure time selector you use may not have the settings suggested. Consult the film manufacturer's instructions regarding the desired time setting to use.

Before you perform an individual radiograph or a full mouth periapical examination, prepare the patient, using the procedures explained earlier. When you are using the parallel film placement technique, the position of the patient's head is not critical. But, it is best to adjust the head rest on the dental chair so that the patient's "plane of occlusion" is parallel with the floor and the "midsagittal plane" is perpendicular to the floor (fig. 1-13.)

It is important to properly position the paralleling devices and the tube head cylinder when using the paralleling placement technique.

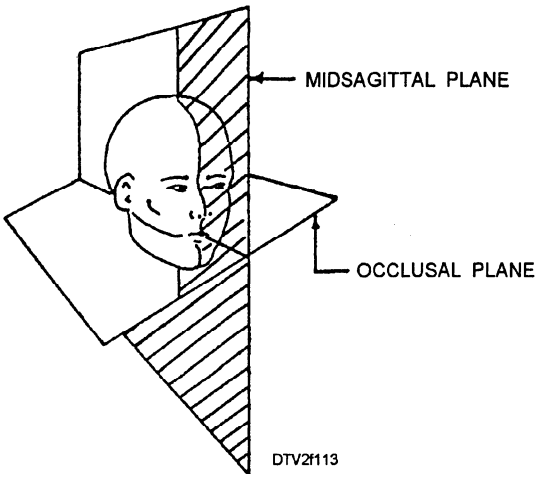


Figure 1-13.—Midsagittal and occlusal planes.

When taking a full mouth series or an individual periapical radiograph, follow the given guidelines for the specific area listed:

NOTE: After each exposure, put the exposed film in a clean paper cup or disposable container. Then place the cup or disposable container in a lead container or behind a protective screen.

- Maxillary Incisor Area

1. Set the exposure time selector to manufacturer's suggested impulses.
2. Prepare the anterior paralleling device.
3. Position the paralleling device with film in the patient's mouth. Center the film on the midline so that it is parallel with the long axis of the incisors (fig. 1-14).
4. Place a cotton roll under the bite-block. Have the patient close gently but firmly.
5. Adjust the locator ring and align the tubehead cylinder as previously described.
6. Make the exposure.

- Maxillary Cuspid Area

1. Set the exposure time selector to manufacturer's suggested impulses.
2. Prepare the anterior paralleling device.
3. Position the paralleling device with film in the patient's mouth. Center the film on the cuspid and parallel with the tooth's long axis (fig. 1-15).
4. Place a cotton roll under the bite-block and have the patient close.
5. Adjust the locator ring and align the tubehead cylinder.
6. Make the exposure.

- Maxillary Bicuspid Area

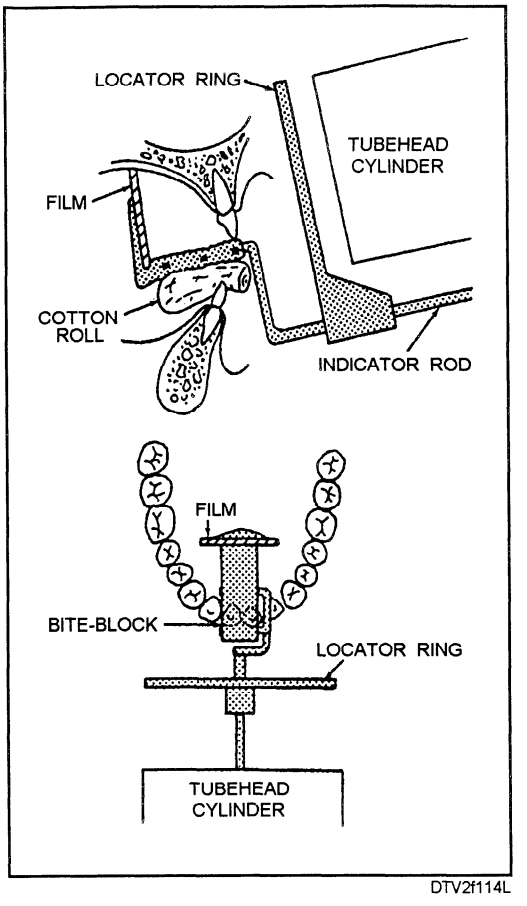
1. Set the exposure time selector to the manufacturer's suggested impulses.
2. Prepare the posterior paralleling device.
3. Position the paralleling device with film in the patient’s mouth. Center the second bicuspid and parallel with the tooth's long axis (fig. 1-16).
4. Place a cotton roll under the bite-block and have the patient close.
5. Adjust the locator ring and align the tubehead cylinder.
6. Make the exposure.

- Maxillary Molar Area

1. Set the exposure time selector to the manufacturer's suggested impulses
2. Prepare the posterior paralleling device.
3. Position the paralleling device with film in the patient's mouth. Center the film on the second molar, so the anterior edge of the film includes at least the distal half of the second bicuspid. The film should be parallel with the long axis of the molars (fig. 1-17).
4. Place a cotton roll under the bite-block and have the patient close.
5. Adjust the locator ring and align the tubehead cylinder.
6. Make the exposure.

- Mandibular Incisor Area

1. Set the exposure time selector to the manufacturer's suggested impulses.
2. Prepare the anterior paralleling device.
3. Position the paralleling device with film in the patient's mouth. Position the film packet so that it is centered on the midline and parallel with the long axis of the incisors (fig. 1-18).
4. Place a cotton roll on the upper surface of the bite-block and have the patient close.
5. Adjust the locator ring and align the tubehead cylinder.
6. Make the exposure.



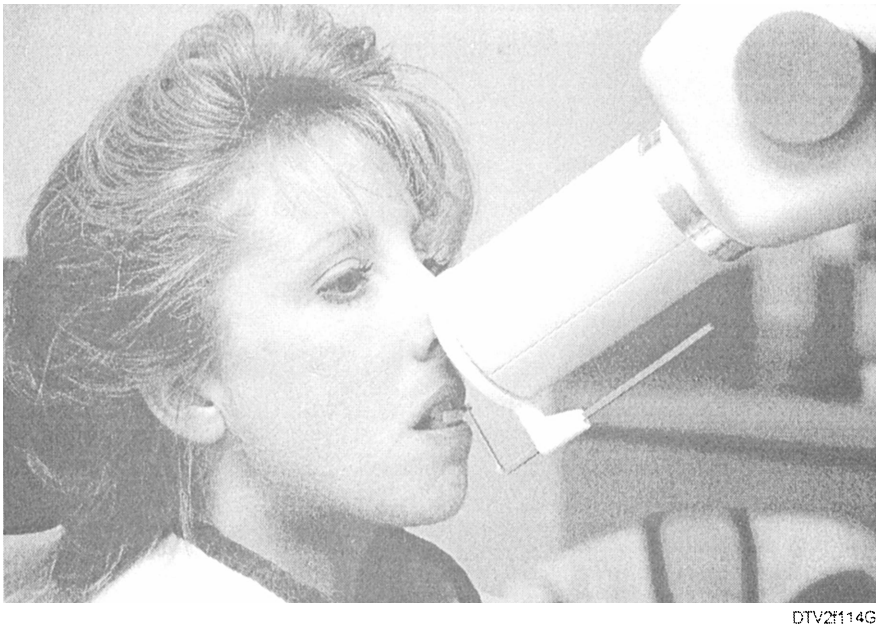


Figure 1-14.—Film and cylinder placement: maxillary incisor area.

- Mandibular Cuspid Area

1. Set the exposure time selector to the manufacturer's suggested impulses.
2. Assemble the anterior paralleling device.
3. Position the paralleling device with film in the patient's mouth. Center the film on the cuspid and parallel with its long axis (fig. 1-19).
4. Place a cotton roll on the upper surface of the bite-block and have the patient close.

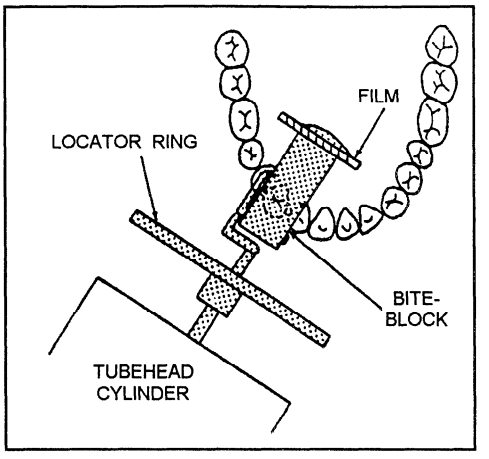


Figure 1-15.—Film and cylinder placement: maxillary cuspid area.

5. Adjust the locator ring and align the tubehead cylinder.

6. Make the exposure.

- Mandibular Bicuspid Area

1. Set the exposure time to the manufacturer's suggested impulses.

2. Assemble the posterior paralleling device.

3. Position the paralleling device with film in the patient's mouth. Position the film packet so that it is centered on the second bicuspid and parallel with its long axis (fig. 1-20).

4. Place a cotton roll on the upper surface of the bite-block and have the patient close.

5. Adjust the locator ring and align the tubehead cylinder.

6. Make the exposure.

- Mandibular Molar Area

1. Set the exposure time to the manufacturer's suggested impulses.

2. Assemble the posterior paralleling device.

3. Position the paralleling device with film in the patient’s mouth. Position the film packet. Center the film on the second molars, so the anterior edge of the film includes at least the distal half of the second bicuspid. The film should be parallel with the long axis of the molars (fig. 1-21).

4. Place a cotton roll on the upper surface of the bite-block and have the patient close.

5. Adjust the locator ring and align the tubehead cylinder.

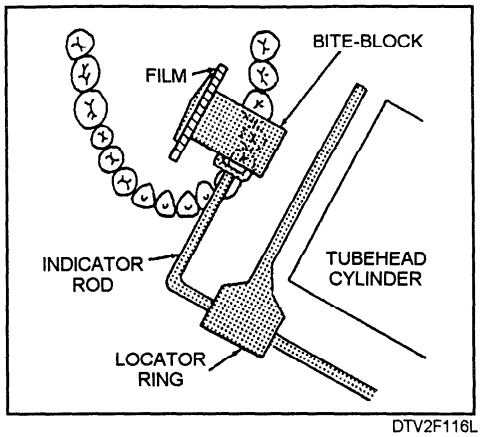


Figure 1-16.—Film and cylinder placement: maxillary bicuspid area.

6. Make the exposure.

VARIATION TO THE EXPOSURE FACTORS AND FILM ALIGNMENT

Some variations to the exposure factors and film alignment may be necessary for a specific area of the patient's anatomy.

The dentist may request a radiograph of an impacted third molar. If so, you would prepare the paralleling device in the usual manner, placing the film packet off center in the backing support so the film extends posteriorly to cover the entire third molar area. When you place the paralleling device in the patient's mouth, position it so the anterior edge of the film includes the distal half of the first molar.

Use special film placement procedures when a patient has a low palatal vault or edentulous arches. Place one cotton roll on each side of the bite-block as shown in figure 1-22. This ensures that the X-ray film will be parallel with the long axis of the teeth being radiographed.

BISECTING-ANGLE TECHNIQUE

Use the bisecting-angle technique when paralleling devices are not available; or when a patient finds it painful or impossible to close on the bite-block; or when an X-ray is needed when a rubber dam is in place. This technique incorporates the use of a tube head with an X-ray source to cylinder end

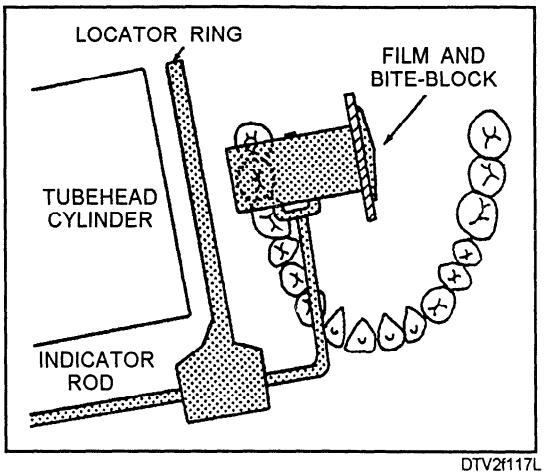


Figure 1-17.—Film and cylinder placement: maxillary molar area.

distance of 8 inches (short cone). **The bisecting-angle technique is not recommended for routine use.**

Since paralleling devices are not used with the bisecting-angle technique, you must pay special attention to positioning the patient, the film packet, and the tube head.

Positioning the Patient

For all maxillary periapical radiographs, position the patient's head as shown in figure 1-23 from the ala of the nose (the outer portion of the nostril) to the tragus of the ear (a projection of the cartilage on the front center of the ear). This ala-tragus line should be parallel with the floor. The patient's head should also be positioned so that the midsagittal plane is perpendicular to the floor.

For mandibular periapical radiographs, lower the headrest so the patient's head is positioned as shown in figure 1-24. The figure shows a line running from the corner of the patient's mouth to the tragus of the ear. This line should be parallel with the floor. Again, the mid-sagittal plane is perpendicular to the floor.

Positioning the Film

Once the patient is positioned, insert the film packet in the patient's mouth with a pair of hemostats or other holding device. Never slide the packet in; this might irritate the oral mucosa or cause the patient to gag. Gently direct the holding device to the desired